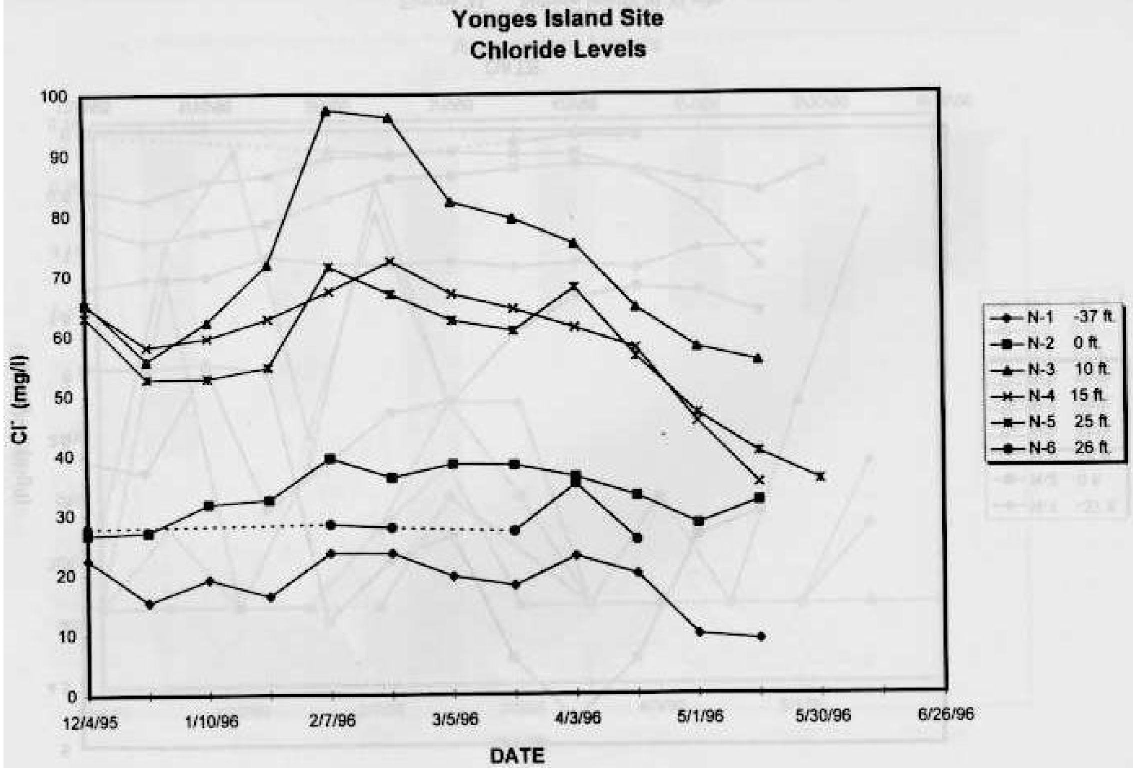


Figure 30. Chloride levels at YI site.

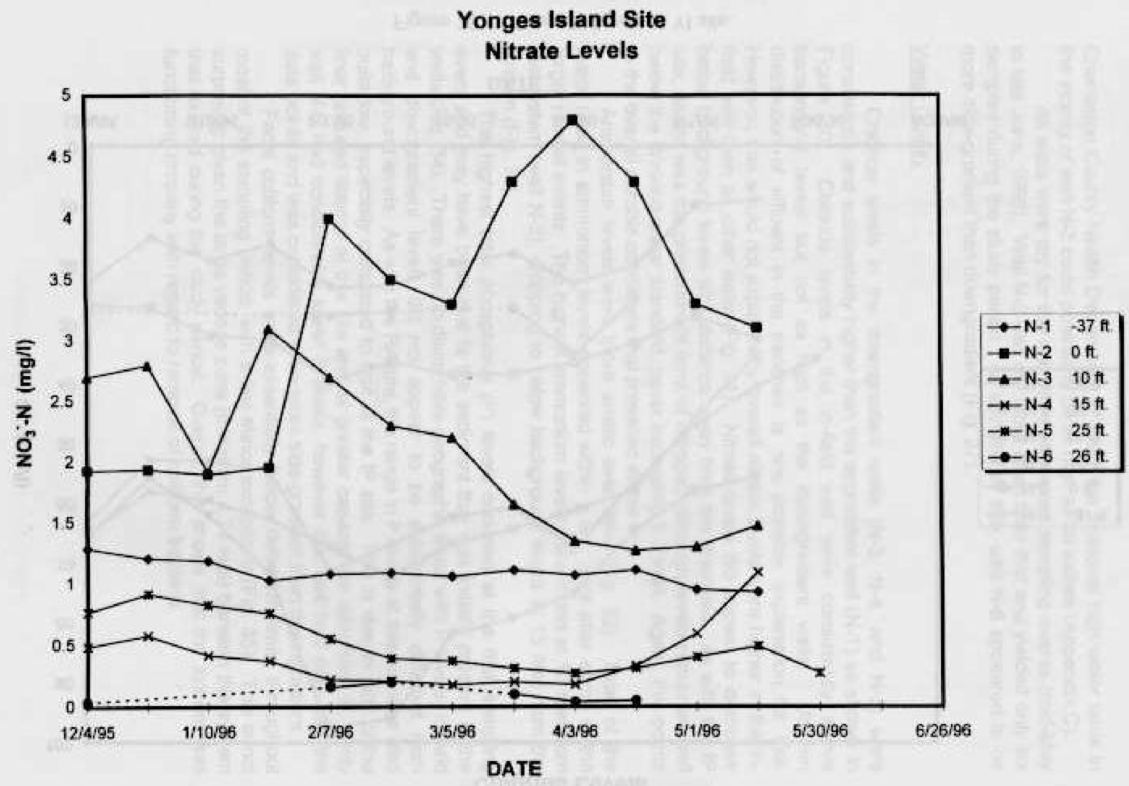


Figure 31. Nitrate levels at YI site.

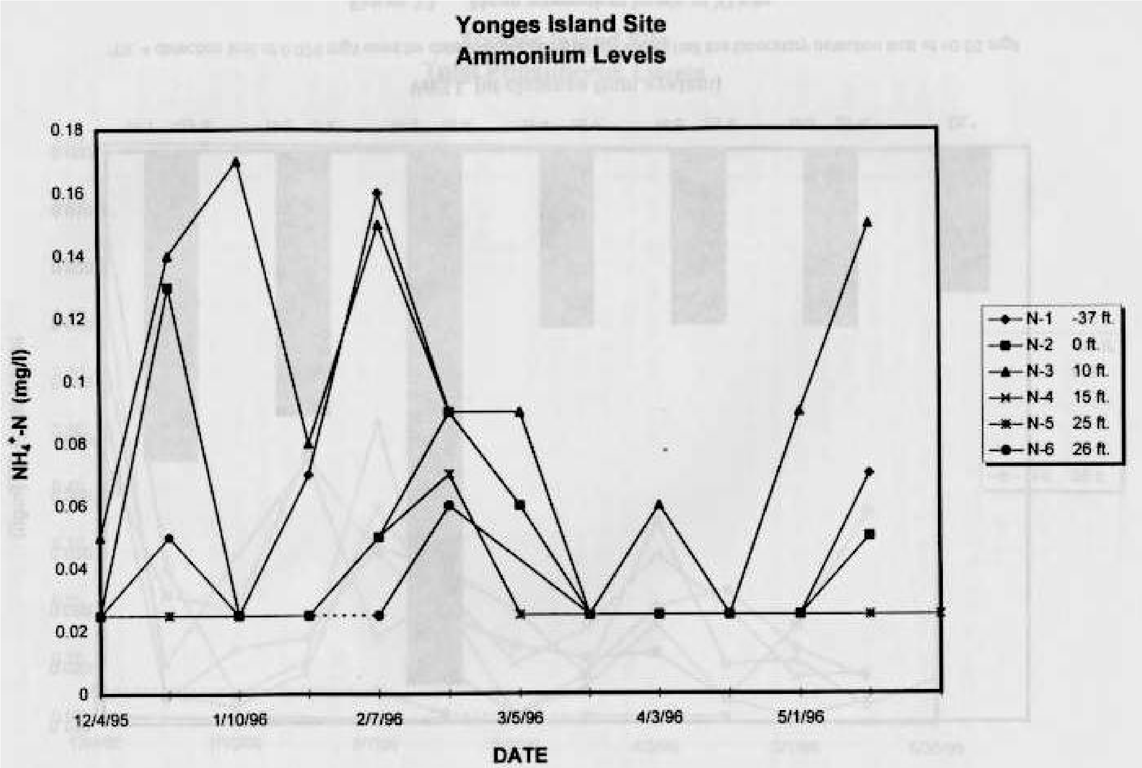
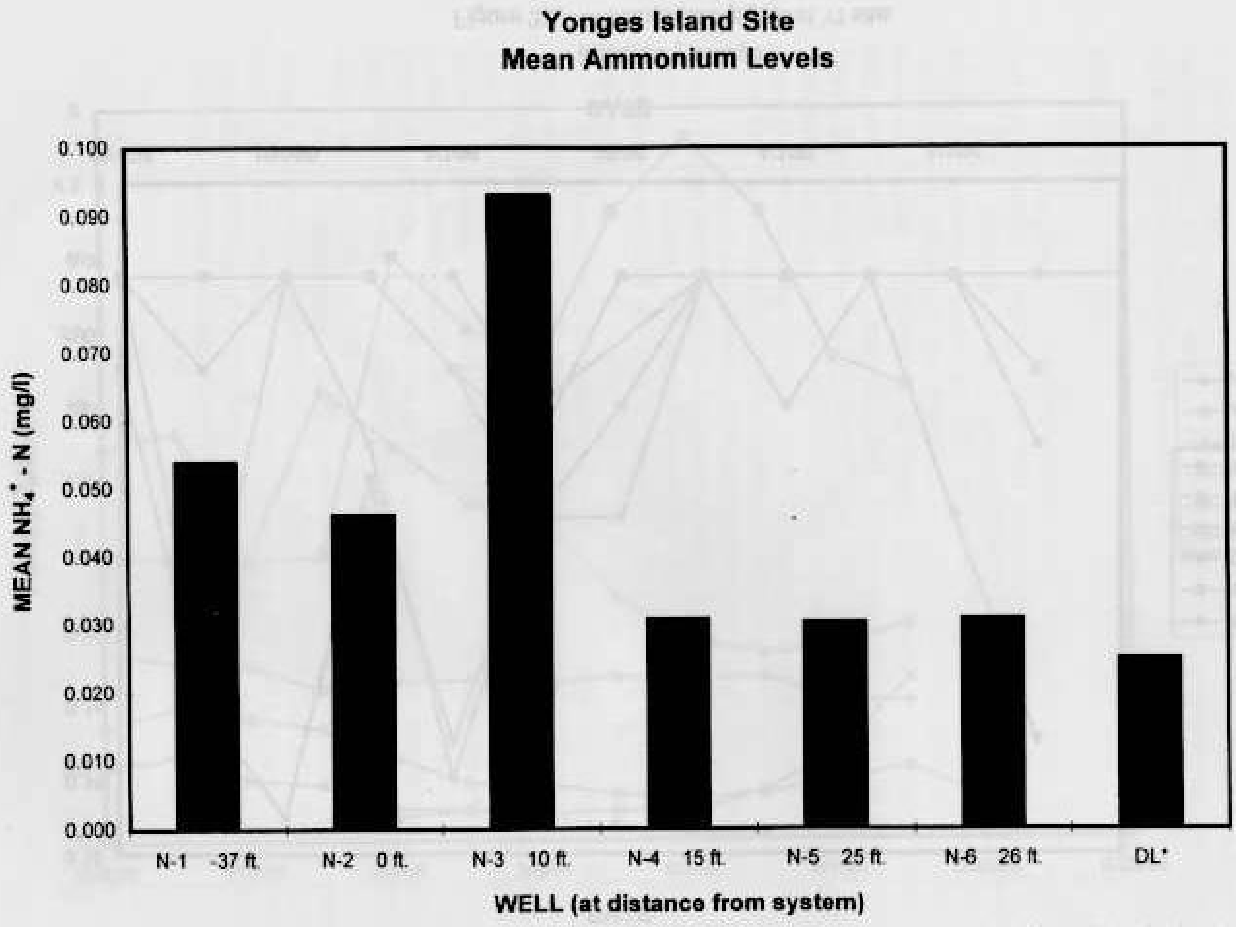


Figure 32. Ammonium levels at YI site.



*DL = detection limit of 0.025 mg/l used for data interpretation, which in one-half the laboratory detection limit of <0.05 mg/l

Figure 33. Mean ammonium levels at YI site.

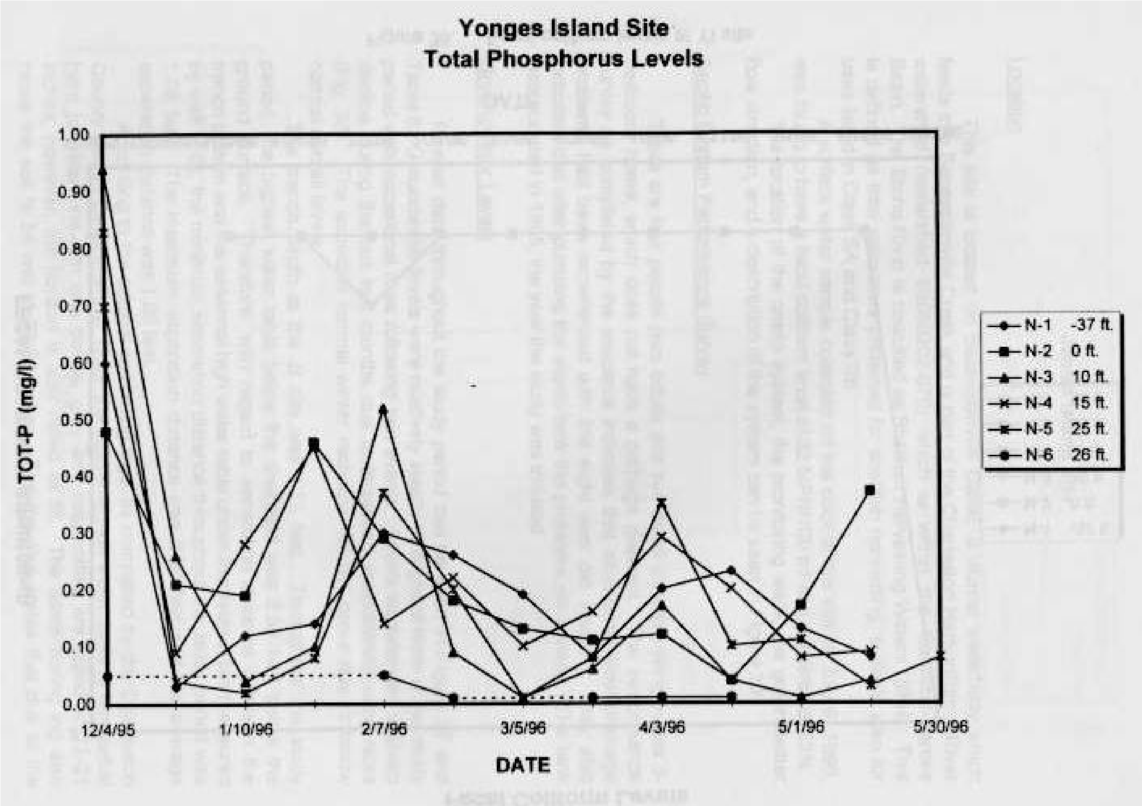


Figure 34. Total phosphorus levels at YI site.

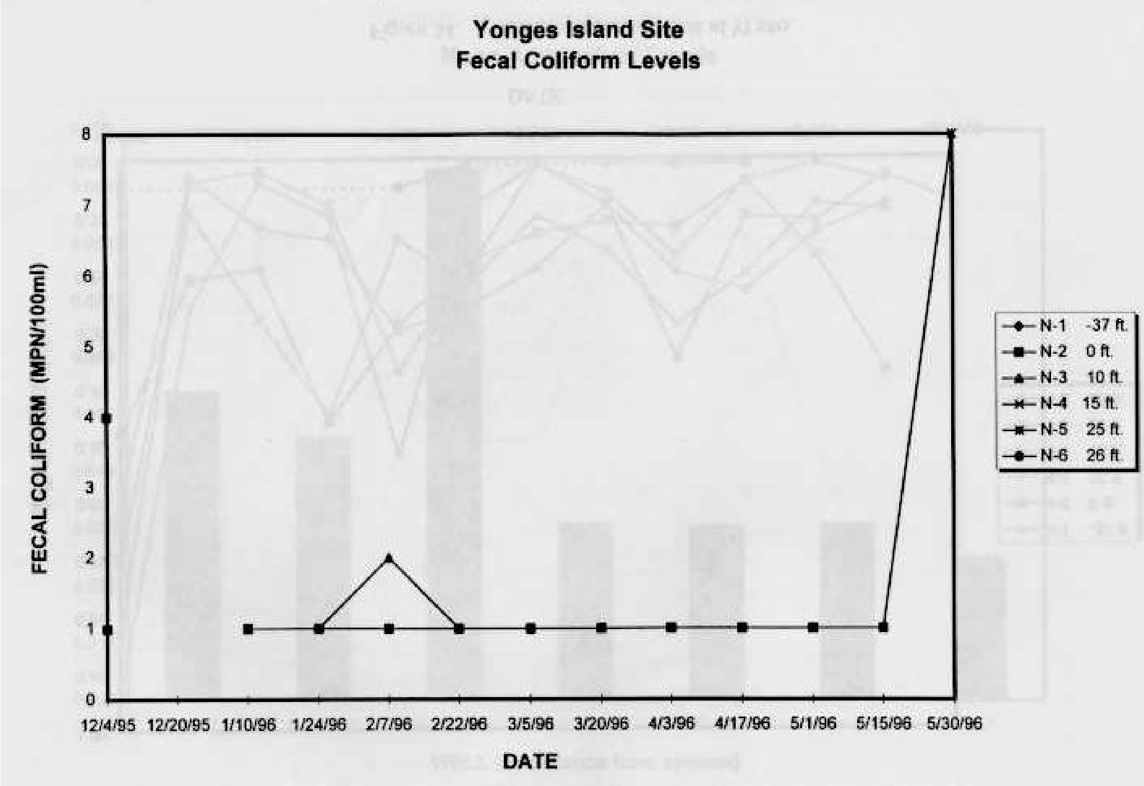


Figure 35. Fecal coliform levels at YI site.

James Island Site

Location

This site is located on Secessionville Canal, a diurnal waterbody which feeds into Secessionville Creek and is part of the Charleston Harbor/Stono River watershed (watershed 03050202-070) which is within the Catawba-Santee Basin. The Stono River is classified as Shellfish Harvesting Waters (SFH). This is defined as tidal saltwaters protected for shellfish harvesting; suitable also for uses listed in Class SA and Class SB.

A surface water sample collected off the dock at this site on July 9, 1996, was found to have a fecal coliform level of 33 MPN/100 ml and a salinity of 33%.

The location of the onsite system, the monitoring wells, the groundwater flow direction, and a description of the system can be seen in Figure 36.

Septic System Performance Survey

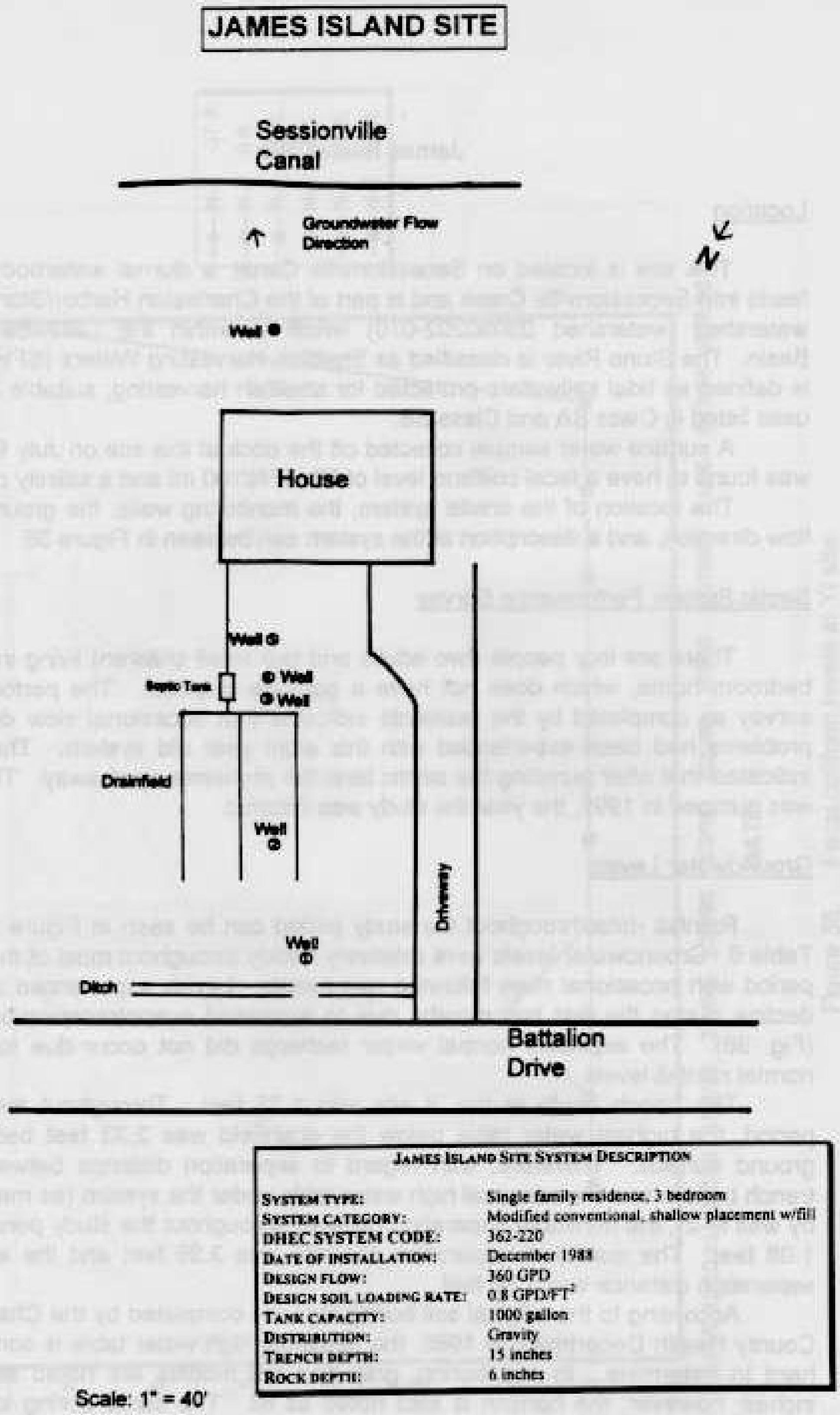
There are four people (two adults and two small children) living in this 3-bedroom home, which does not have a garbage disposal. The performance survey as completed by the residents indicates that occasional slow drainage problems had been experienced with this eight year old system. They also indicated that after pumping the septic tank the problems went away. The tank was pumped in 1995, the year the study was initiated.

Groundwater Levels

Rainfall data throughout the study period can be seen in Figure 37 and Table 6. Groundwater levels were relatively steady throughout most of the study period with occasional rises following rain events. Levels experienced a sharp decline during the last two months due to increased evapotranspiration rates (Fig. 38). The expected normal winter recharge did not occur due to below normal rainfall levels.

The trench depth at the JI site was 1.25 feet. Throughout the study period, the highest water table below the drainfield was 2.33 feet below the ground surface. Therefore, with regard to separation distance between the trench bottom and the seasonal high water table under the system (as measured by well M-2), the minimum separation distance throughout the study period was 1.08 feet. The maximum separation distance was 3.26 feet and the average separation distance was 1.96 feet.

According to the original soil boring logs, as completed by the Charleston County Health Department in 1986, the seasonal high water table is somewhat hard to determine. In one boring, gray and red mottles are noted at 12-21 inches; however, the horizon is also noted as fill. The same boring log also notes the soil to be wet at 29-36 inches. The log also states that due to the original permit issuance date of 1979, the permit had to be honored even though the regulations and soil evaluation techniques had been changed since then (Appendix D).



JAMES ISLAND SITE SYSTEM DESCRIPTION

SYSTEM TYPE:	Single family residence, 3 bedroom
SYSTEM CATEGORY:	Modified conventional, shallow placement w/fill
DHEC SYSTEM CODE:	362-220
DATE OF INSTALLATION:	December 1988
DESIGN FLOW:	360 GPD
DESIGN SOIL LOADING RATE:	0.8 GPD/FT^2
TANK CAPACITY:	1000 gallon
DISTRIBUTION:	Gravity
TRENCH DEPTH:	15 inches
ROCK DEPTH:	6 inches

Figure 36. James Island site map.

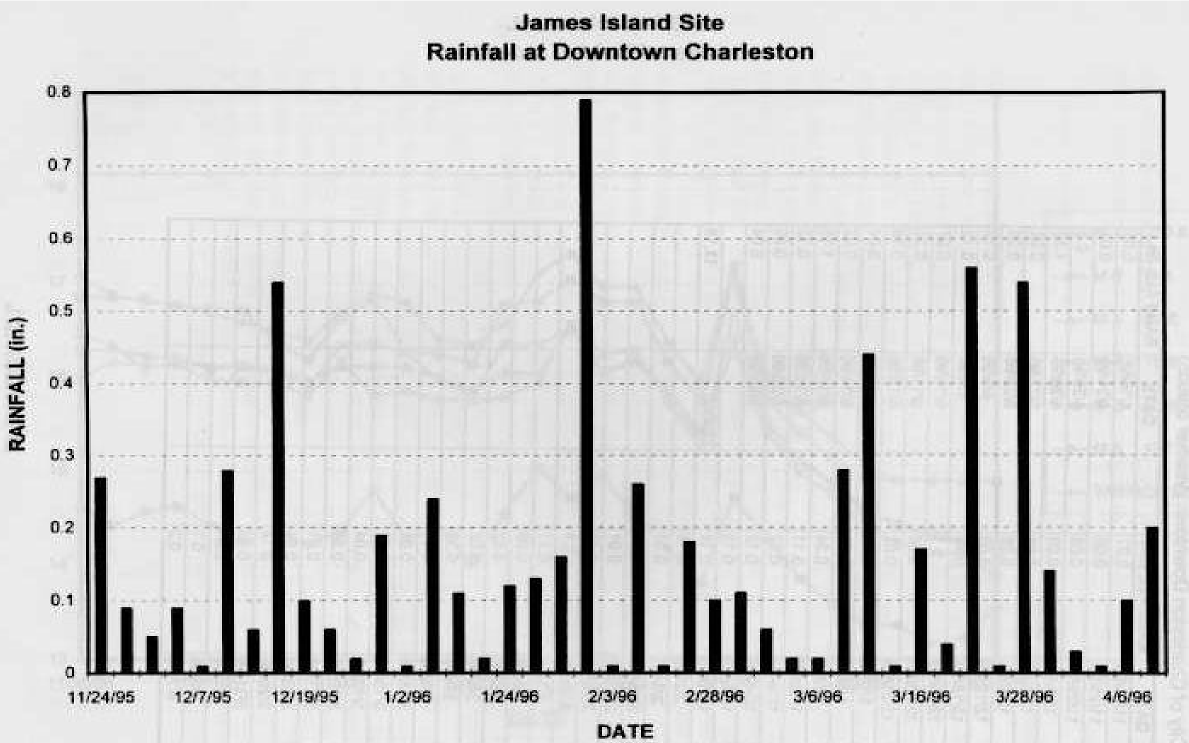


Figure 37. Rainfall at station closest to JI site.

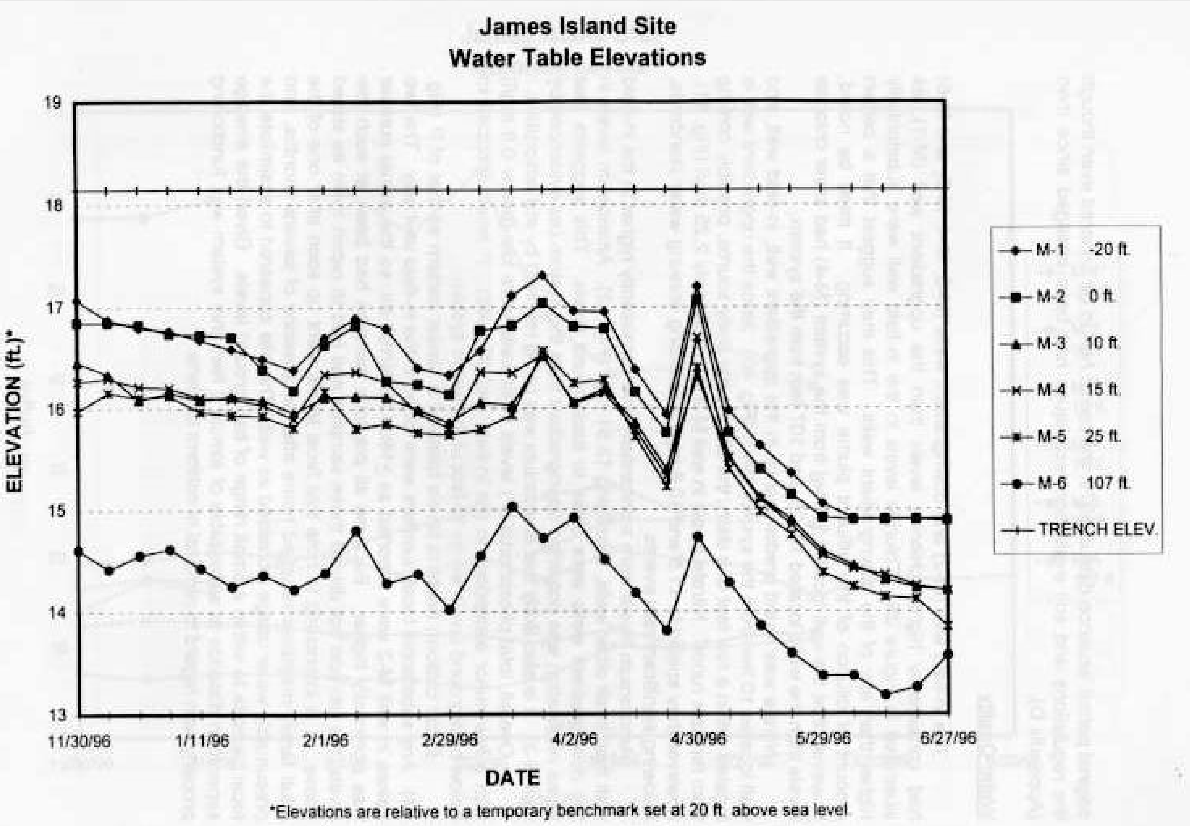


Figure 38. Water table elevations at JI site.

Table 6. Rainfall data for station closest to JI site.
(City of Charleston Downtown Weather Station)

DATE	RAINFALL (in.)	DATE	RAINFALL (in.)
11/24/95	0.27	4/16/96	0.08
11/25/95	0.09	4/24/96	0.03
11/29/95	0.05	4/26/96	0.5
12/6/95	0.09	4/30/96	1.39
12/7/95	0.01	5/27/96	0.02
12/9/95	0.28	5/28/96	0.25
12/10/95	0.06	6/5/96	0.12
12/18/95	0.54	6/9/96	0.12
12/19/95	0.1	6/10/96	0.07
12/30/95	0.06	6/11/96	0.32
12/31/95	0.02	6/12/96	0.16
1/1/96	0.19	6/13/96	0.04
1/2/96	0.01	6/14/96	0.02
1/7/96	0.24	6/16/96	1.18
1/12/96	0.11	6/19/96	0.12
1/19/96	0.02	6/20/96	0.06
1/24/96	0.12	6/25/96	0.04
1/27/96	0.13		
1/31/96	0.16	**TOTAL**	11.16
2/2/96	0.79		
2/3/96	0.01		
2/15/96	0.26		
2/16/96	0.01		
2/20/96	0.18		
2/28/96	0.1		
3/1/96	0.11		
3/2/96	0.06		
3/5/96	0.02		
3/6/96	0.02		
3/7/96	0.28		
3/8/96	0.44		
3/15/96	0.01		
3/16/96	0.17		
3/17/96	0.04		
3/18/96	0.56		
3/27/96	0.01		
3/28/96	0.54		
3/29/96	0.14		
3/31/96	0.03		
4/1/96	0.01		
4/6/96	0.1		
4/7/96	0.2		

Water Quality

The in-field well (M-2) and downgradient wells (M-3, M-4, M-5, and M-6) had consistently higher chloride levels than the upgradient well (M-1), as illustrated in Figure 39. Chloride levels in the in-field well were substantially higher than any of the downgradient wells. This may suggest that a certain amount of dilution of the effluent plume was occurring. It must be noted, however, that the well located 16 feet from the system (M-4) had lower chloride levels than the wells located 10, 25, and 107 feet from the system.

Nitrate was found predominantly in the upgradient well, in-field well, and well located 10 feet from the system (M-3) (Fig. 40). Since the upgradient well is located within a few feet of a ditch, the ditch is the likely source, possibly coming from fertilizer runoff. Nitrate levels in well M-3 averaged only 2.25 mg/l (Fig. 41), however they spiked to 11.5 and 10.6 mg/l, exceeding drinking water standards, following significant rain events.

Ammonium levels were substantially and consistently higher in the in-field well than in all other wells, averaging 13.51 mg/l (Fig. 42). Ammonium levels in the downgradient wells were close to background levels. This suggests that some nitrification was occurring downgradient from the system (as evidenced by well M-3). It is also likely that ammonium was being retained by soil adsorption.

Overall, total phosphorus (P) levels in all wells were low (below 0.8 mg/l) with a few minor exceptions in the in-field well (Fig. 43). P levels dropped to below background levels within 10 feet of the septic system.

Fecal coliform bacteria levels followed a similar pattern as that of P (Fig. 44). Any substantial fecal numbers were found in the in-field well only. The two spikes in well M-2 were reported as ≥1600 MPN/100 ml, so the actual number was potentially higher. Because all previous samples had been at such low levels, the lab had not diluted these samples and had to report them as stated above. It is interesting to note that fecal levels went up soon after one of the adult family members returned home after an absence of several months, and presumably water usage increased as well. The site appeared to assimilate the fecal bacteria to within a small range of background levels. Given the average separation distance to water table of almost 2 feet, this system was functioning properly with regard to removal of coliform bacteria.

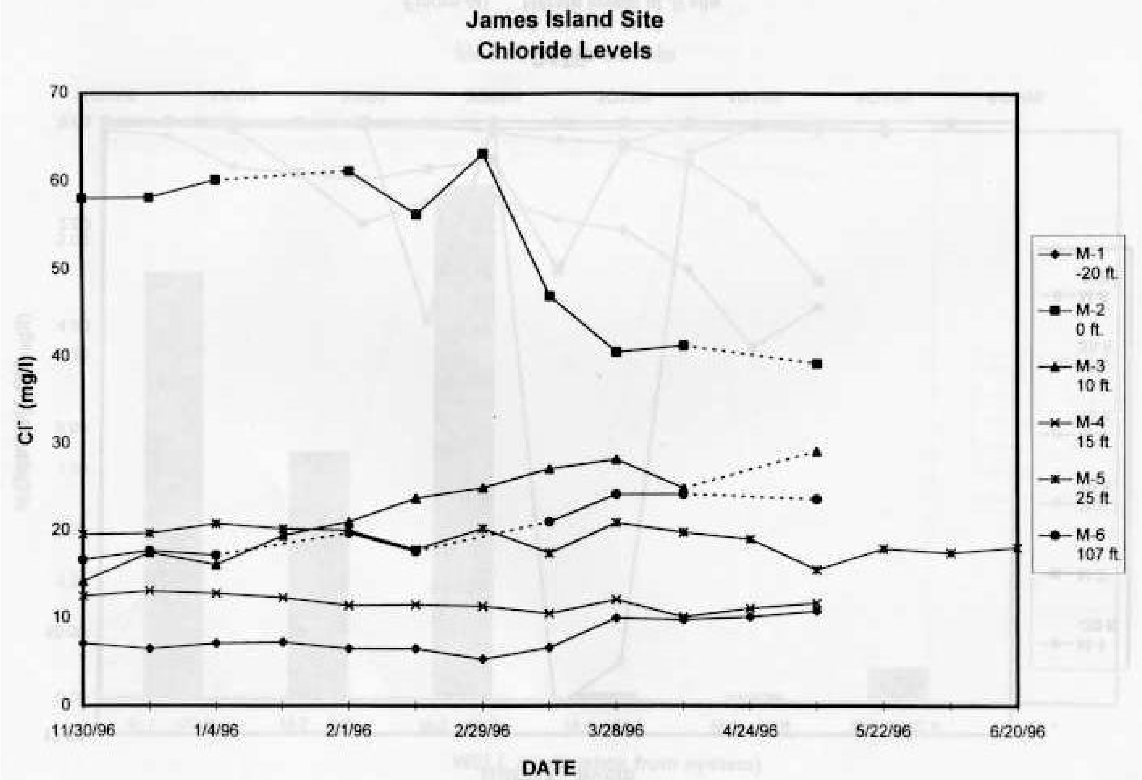


Figure 39. Chloride levels at JI site.

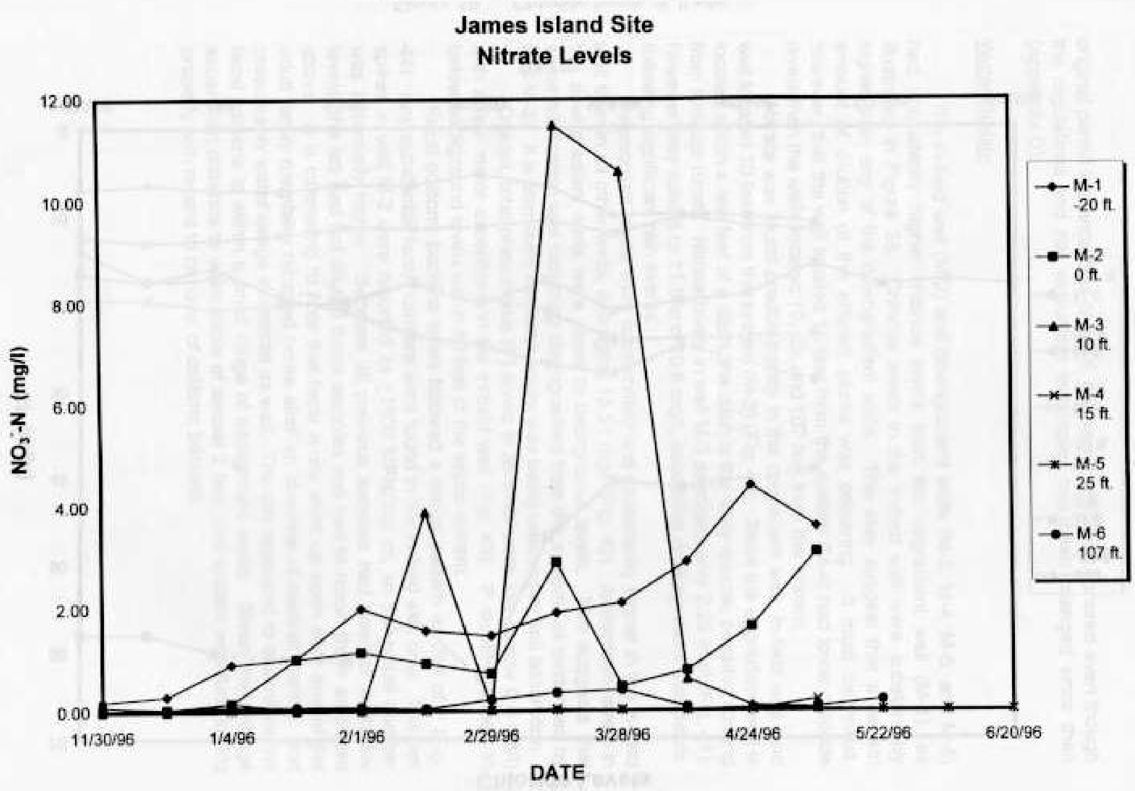
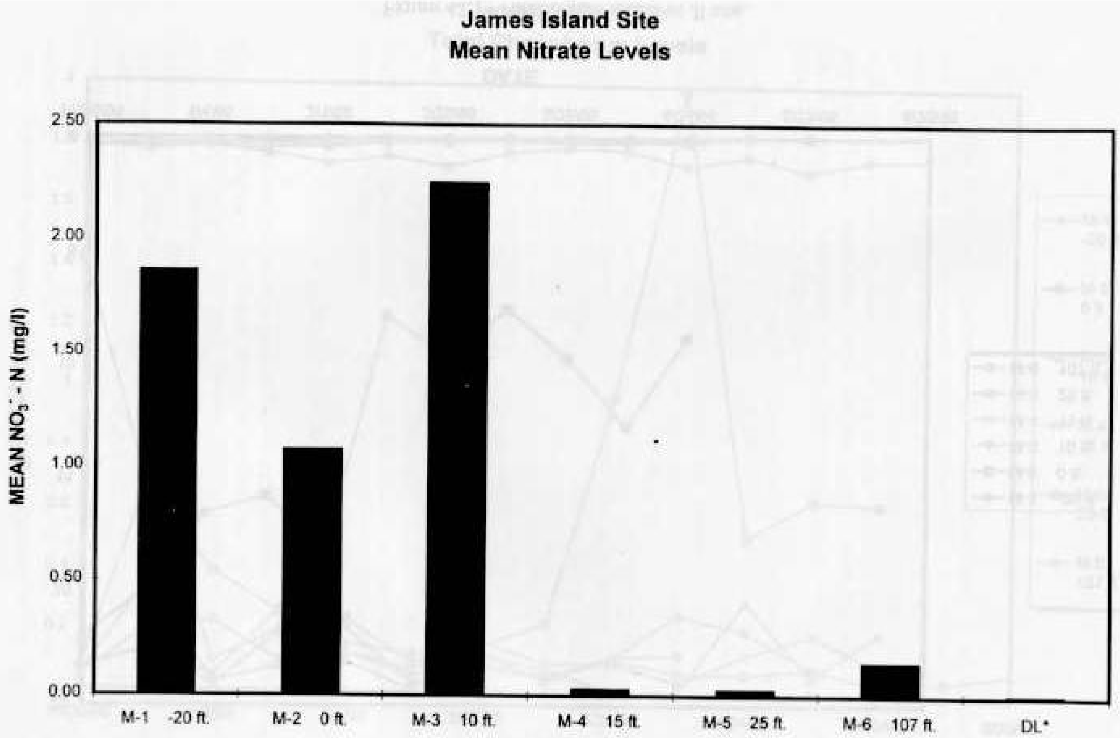


Figure 40. Nitrate levels at JI site.



*DL = detection limit of 0.01 mg/l used for data interpretation, which is one-half the laboratory detection limit of <0.02 mg/l

Figure 41. Mean nitrate levels at JI site.

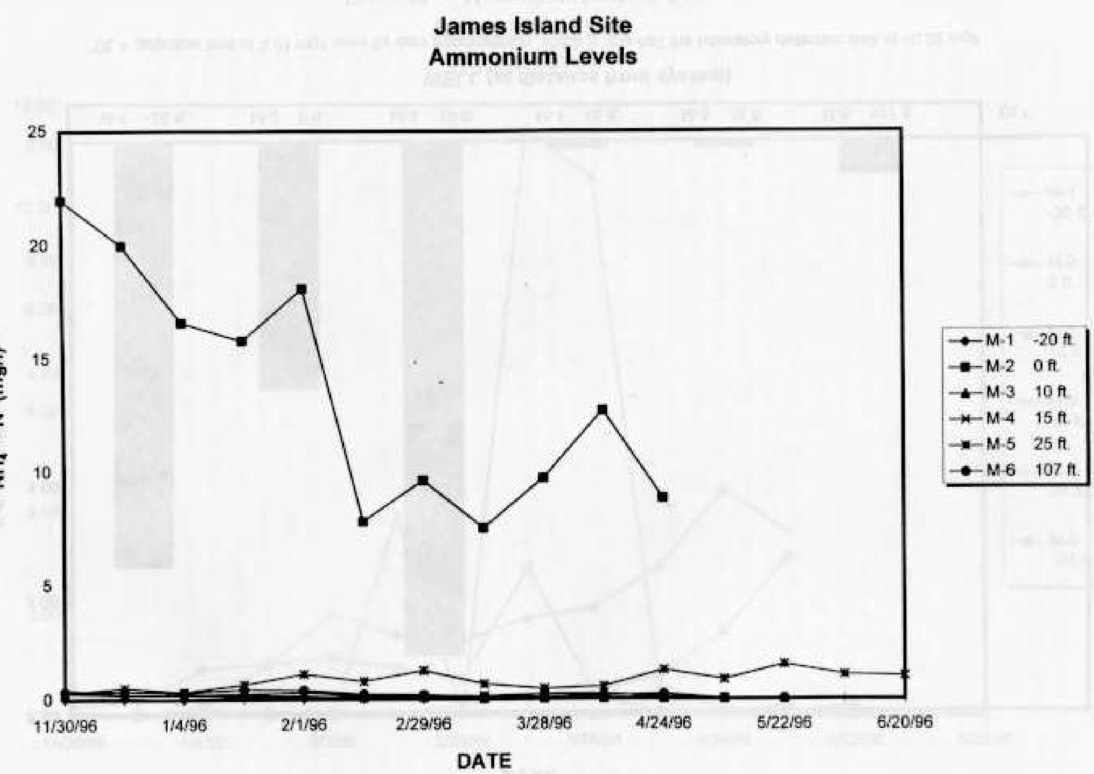


Figure 42. Ammonium levels at JI site.

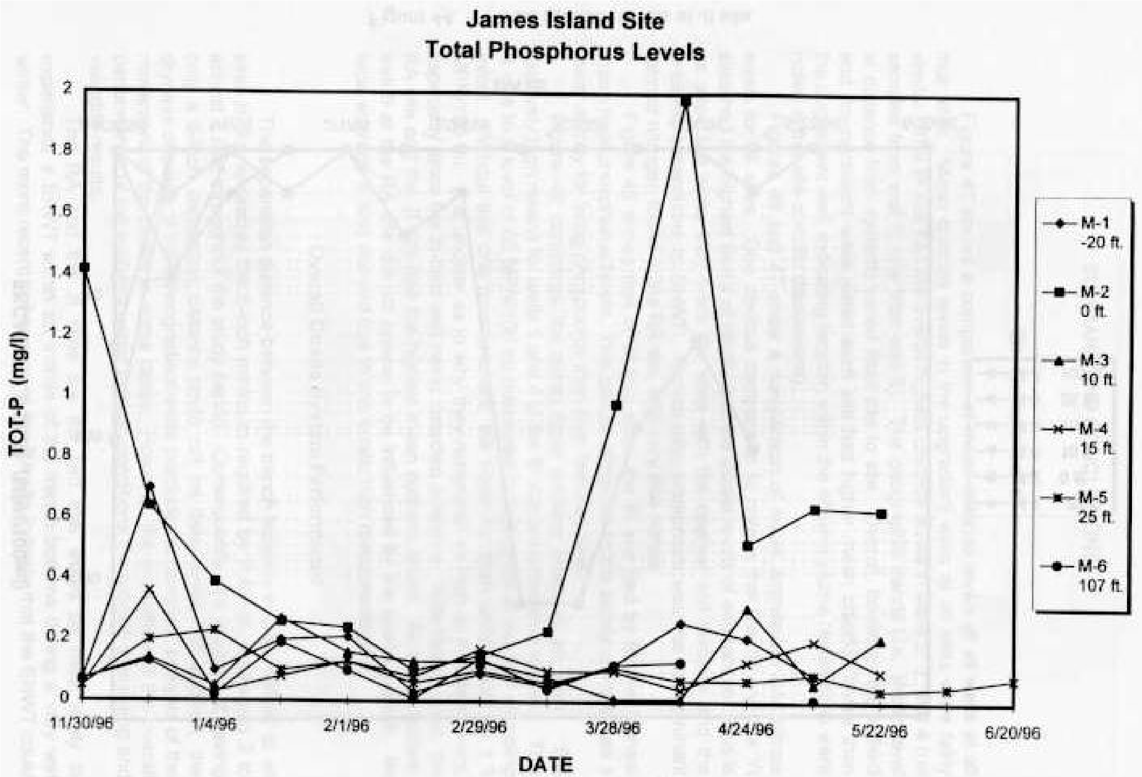


Figure 43. Total phosphorus levels at JI site.

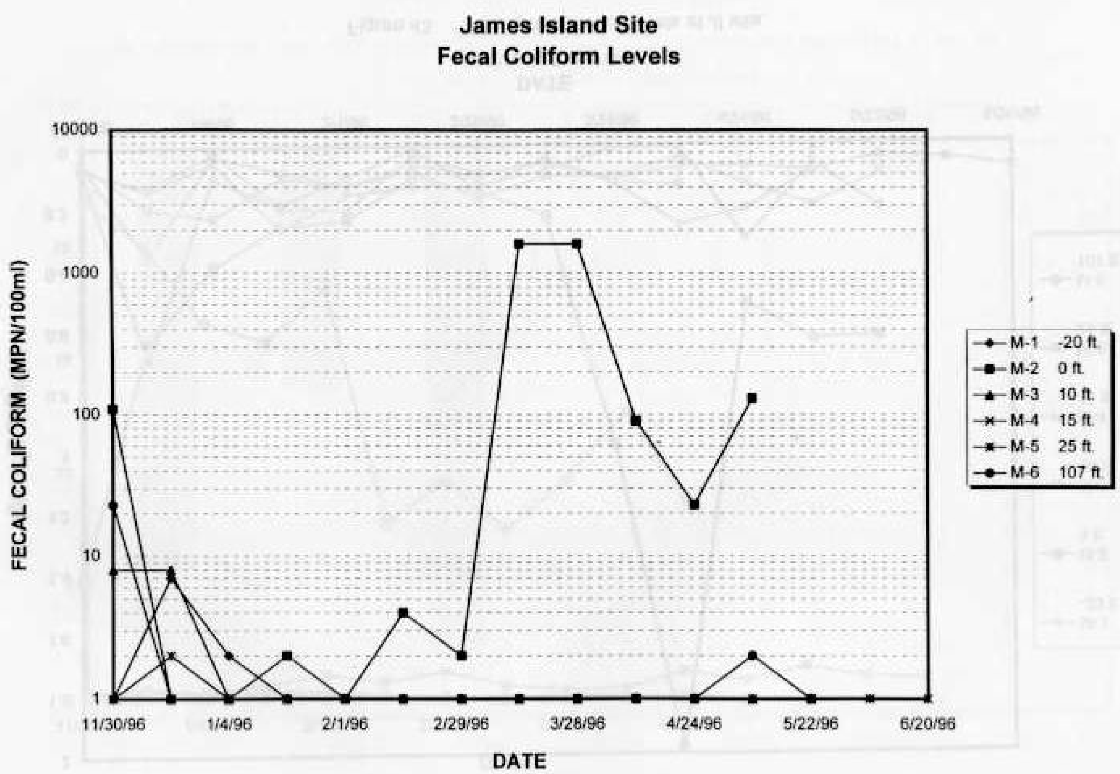


Figure 44. Fecal coliform levels at JI site.

SUMMARY AND CONCLUSIONS

Site Comparisons

Figure 45 shows a comparison of mean chloride levels of all wells at all four sites. Mean chloride levels in the upgradient wells at all sites were fairly similar. The IP site had the overall highest chloride levels in wells 2, 3, and 4 (no samples from well 5; one from well 6). The geographic trends (i.e., mean level at distance from system) varied from site to site. Overall, however, the in-field and downgradient wells within each site had higher mean chloride levels than the upgradient well, indicating location within the effluent plume (exceptions were noted in the site-specific discussions).

Figures 46 and 47 show a comparison of mean ammonium and nitrate levels for all sites. One obvious comparison to note is that the IP and the YI sites had the highest levels of nitrate and the lowest levels of ammonium. This is as expected since they were the sites with the coarser soil textures and the greatest separations to SHWT. Conversely, ammonium was the predominant form of nitrogen found at the RA site, with very little nitrate.

Figure 48 shows that of all four sites, the IP site had by far the highest mean total phosphorus levels. This can be attributed to the sandy soil that has a lower affinity for fixing phosphorus than finer textured soils.

Figure 49 compares the mean fecal coliform levels at all sites. The relatively high means for wells 1 and 4 at the IP site are somewhat skewed. This is due to a level of 80 MPN/100 ml measured in both wells at the first sampling event. Without this one measurement, the mean for both wells would be 1.3 MPN/100 ml. It is unclear as to why they measured so high at that one event, especially since the in-field well never detected coliforms. With that in mind, the RA site and the JI site had the highest mean coliform levels. As stated before, well 6 at the RA site did not appear to be influenced by the onsite system. Its fecal average is also skewed due to one erratic high measurement.

Overall Onsite System Performance

The separation distance between the trench bottoms and the SHWT at all sites by far exceeded the 6-inch minimum required by R.61-56, averaging 2 to almost 7 feet throughout the study period. Consequently, the impacts of having *only* a 6-inch separation distance could not be determined. In addition, the dryness of some of the downgradient wells precluded a complete analysis of the movement of the plume in some cases. However, the evaluation of the overall performance of the systems under existing conditions did provide interesting and valuable results.

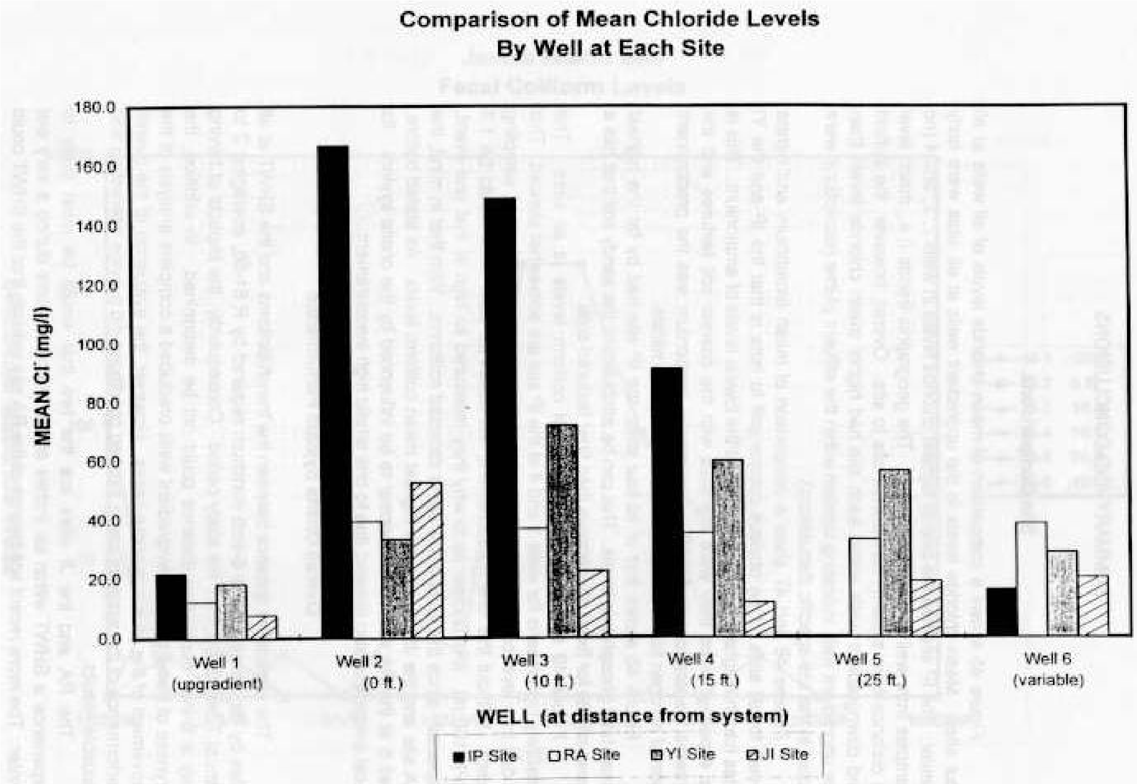


Figure 45. Mean chloride levels at each site.

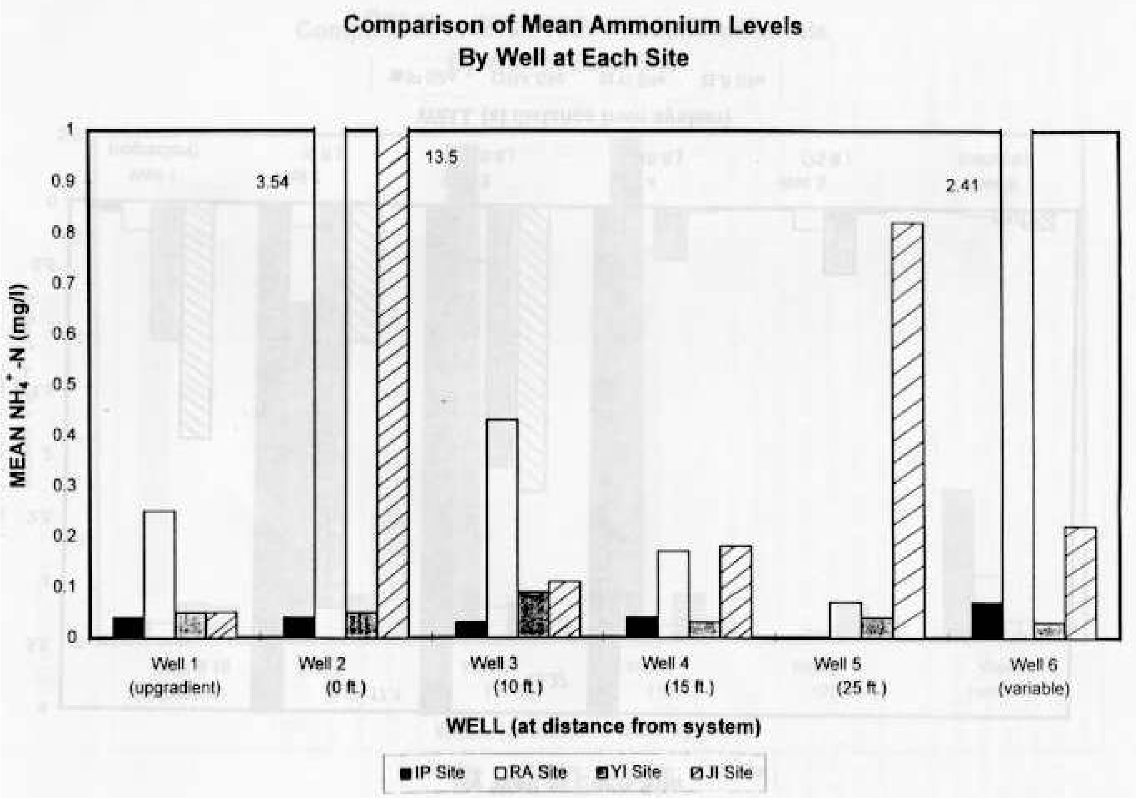


Figure 46. Mean ammonium levels at each site.

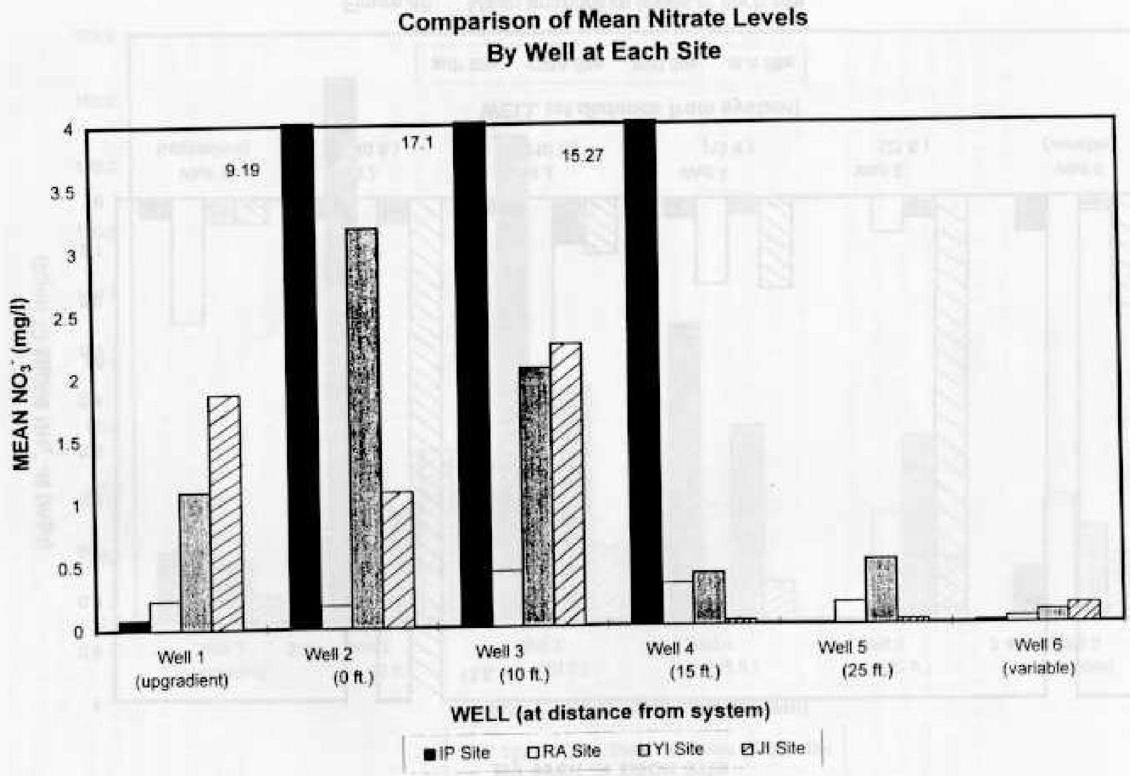


Figure 47. Mean nitrate levels at each site.

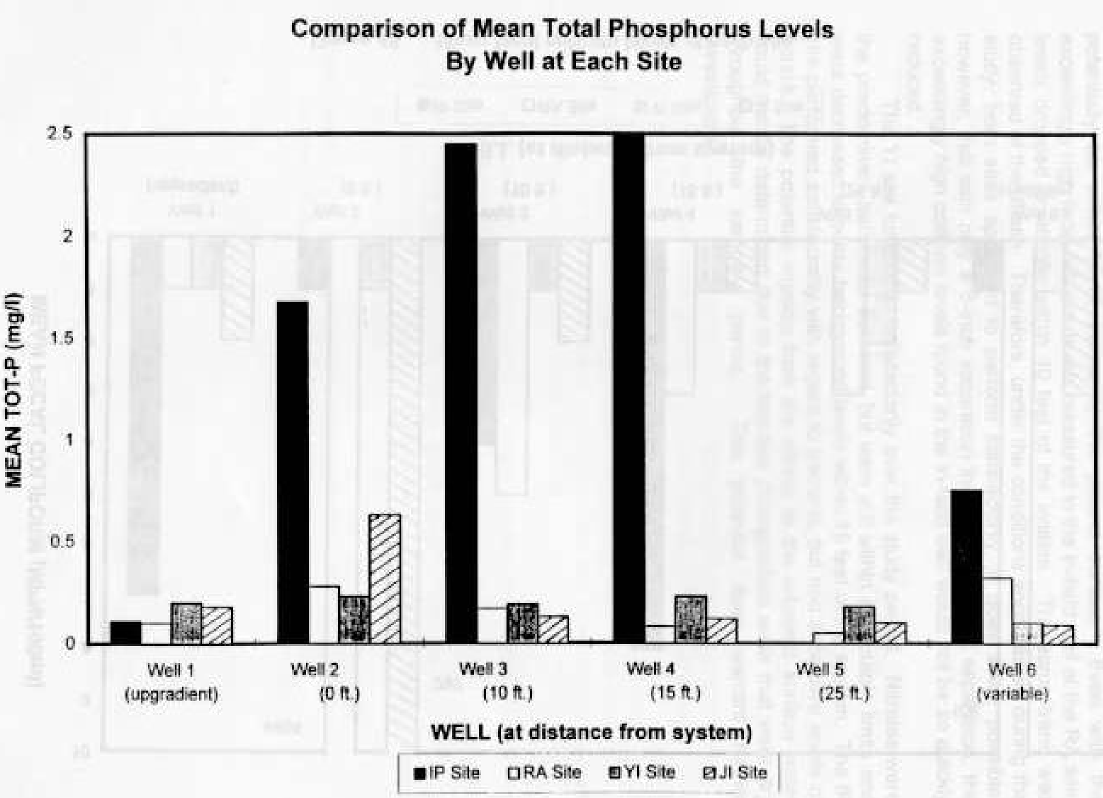


Figure 48. Mean total phosphorus levels at each site.

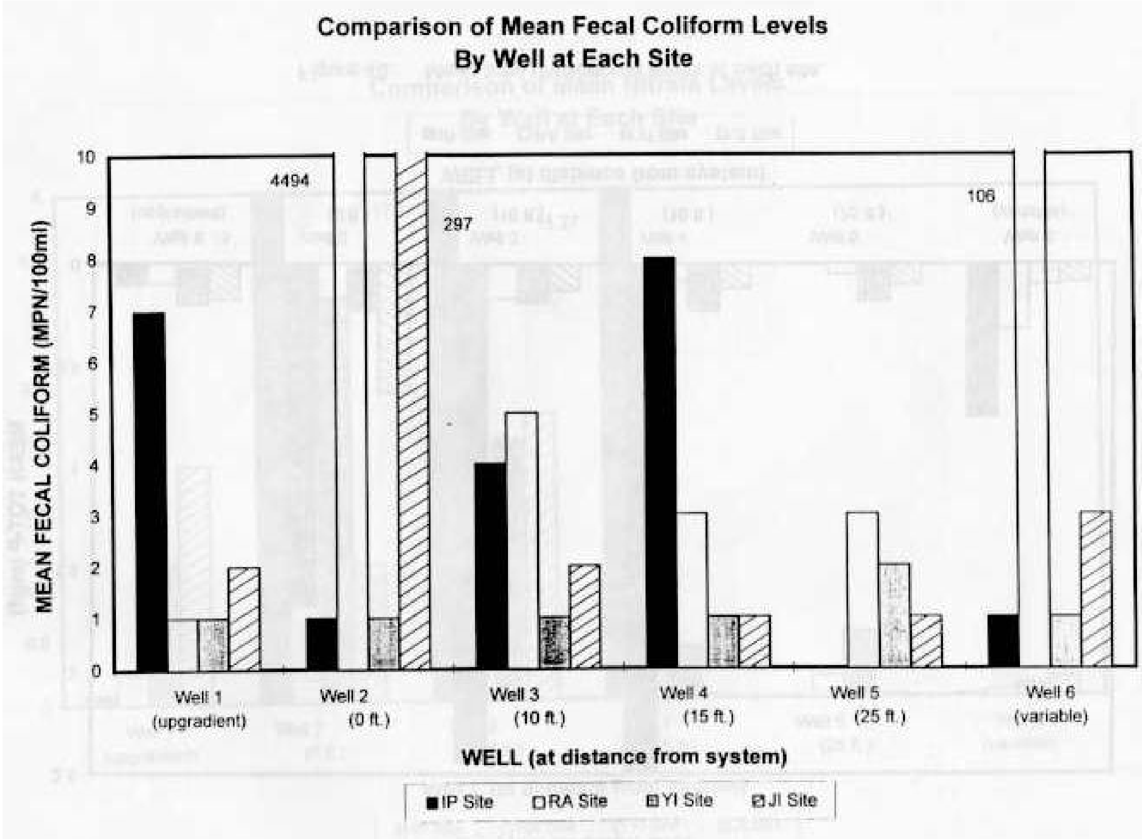


Figure 49. Mean fecal coliform levels at each site.

The RA and the JI sites are the two that would be most likely to experience a SHWT within six inches of the trench bottoms during a very wet winter. The more recent soil borings at the RA site indicate that the SHWT could potentially be within 10-12 inches of the ground surface. Even with the exceedingly high fecal coliform levels measured in the in-field well at the RA site, levels dropped drastically within 10 feet of the system. The same trend was observed at the JI site. Therefore, under the conditions encountered during the study, both sites appeared to perform satisfactorily. It does seem possible, however, that with only a 6-inch separation instead of a 4-foot separation, the exceedingly high coliform levels found in the in-field well would not be so quickly reduced.

The YI site functioned satisfactorily over the study period. Nitrates were the predominant parameter detected, but were still within acceptable limits and were decreased to below background levels within 15 feet of the system. The IP site performed satisfactorily with regard to bacteria, but had excessive levels of nitrate. The potential impacts from the nitrate to the adjacent surface water could not be determined due to the last two downgradient wells that were dry throughout the sampling period. This potential does warrant further investigation.

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APPENDIX A

ONSITE PERMITS

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL
PERMIT TO CONSTRUCT—CERTIFICATE OF FINAL APPROVAL
INDIVIDUAL SEWAGE DISPOSAL SYSTEM

File Isle of Palm

Permit No. 301439-82 Date Issued 10-25-82
Name ____ Mailing Address Isle of Palms
Location Subdevelopment Isle of Palms TM# 568-11-00-016
Street Palm Blvd. Block B Lot ____

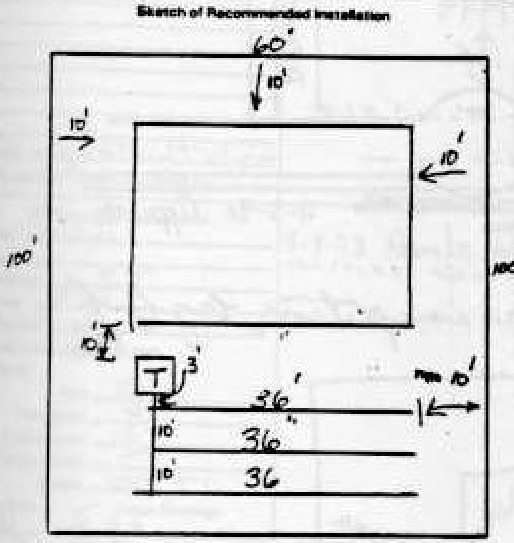
THIS PERMIT BECOMES VOID 12 MONTHS AFTER DATE OF ISSUE

SYSTEM SPECIFICATIONS

Sewage Disposal System Contractor ____
No. Bedrooms 3
Tank Size 1000 Gal
Trenches: Length 133 Feet
Width 36 inches
Tank Manufacturer ____
Pipe Manufacturer(s) ____
Well Installed At Time Of Final Inspection ___ Yes ___ No
Actual Distance To: Well ____
Foundation ____
Property Line ____
Special Instructions install as sketched - conventional depth.

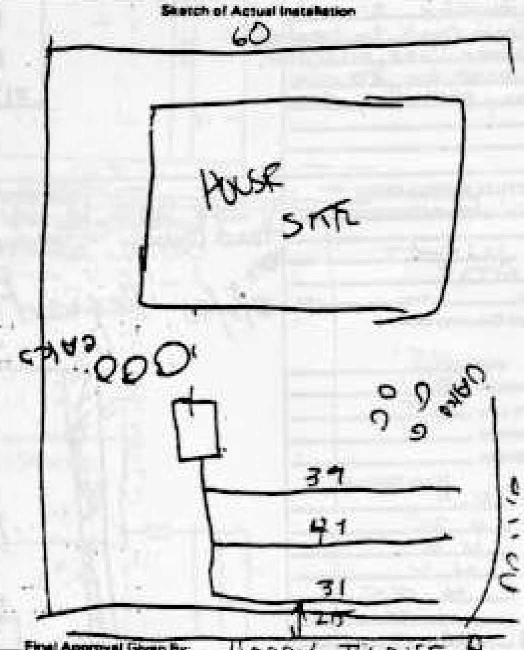
Make sketches illustrating: lot dimensions, if less than 2 acres; location of building; tank location; detailed layout of tile field; location of well; location of driveway; absorption trench elevations.

Sketch of Recommended Installation



Palm Blvd.

Sketch of Actual Installation



Permit Issued By: J.W. Cook
Date Issued: 10-26-82
Final Approval Given By: Harry Turner
Date Approved: 6-7-91

THIS CERTIFICATE OF FINAL APPROVAL IN NO WAY GUARANTEES THE LIFE OF THE SYSTEM OR THAT IT WILL FUNCTION PROPERLY UNDER ANY OR ALL CONDITIONS. NO ADDITIONAL CONNECTIONS TO THE ABOVE SYSTEM OR THE ADDITION OF OTHER SYSTEMS OF THE LOT WILL BE PERMITTED.

Onsite permit for IP site

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL
PERMIT TO CONSTRUCT - CERTIFICATE OF FINAL APPROVAL
INDIVIDUAL SEWAGE TREATMENT AND DISPOSAL SYSTEM

Permit No. 1102-88 Type Facility SFR 4Brs System Category 362-230

Name ______ Mailing Address ______ Ravenel, S.C. 29470

Subdevelopment St. Pauls Parish TMS 245-00-00-007 Street ______ Block ______ Lot ______ Type Water Supply private

SYSTEM SPECIFICATIONS

Max. Est. Daily Flow 480 gpd
Loading Rate .8 gpd/ft²
Tank Size(s) 1000 gallon

Trenches Length 270'
Width 36"
Max Depth 15"
Stone Depth 9"

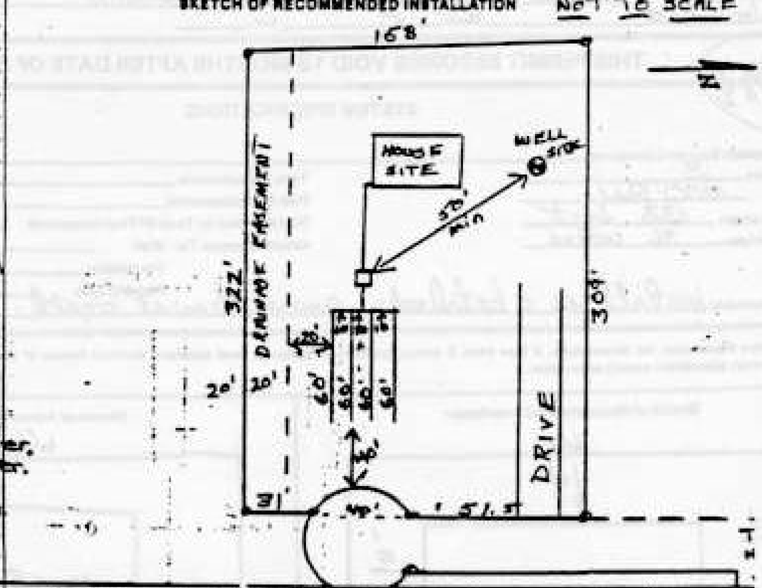
Min. Pump Capacity N/A gpm
at N/A ft. of Head

SPECIAL INSTRUCTIONS/CONDITIONS

Install in area flagged out and per attachment.

Do not pack drive or build over system. Ensure plumbing stub out is compatible with trench depths. 3' solid line from tank to header. 10' between lines, on center. Well must be 50 min from any part of system.

SKETCH OF RECOMMENDED INSTALLATION NOT TO SCALE



ACTUAL INSTALLATION

Installer Wilson

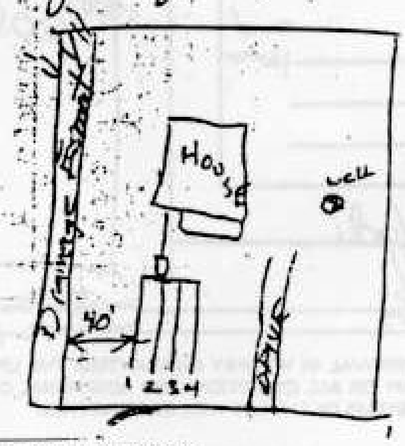
Tank(s) Mfg. West
Pipe Mfg. ADS
Well Installed ______ Yes ______ No
Nearest Actual Distances from System to:
Well 85'
Foundation 20'
Property Line 45
Impoundment ______
Stream ______

Line No.	Grade Readings
IN	4.4
OUT	4.75
1	4.5
2	4.4
3	4.45
4	4.5-5.5
TRENCH	14-17
ROCK	9-11"

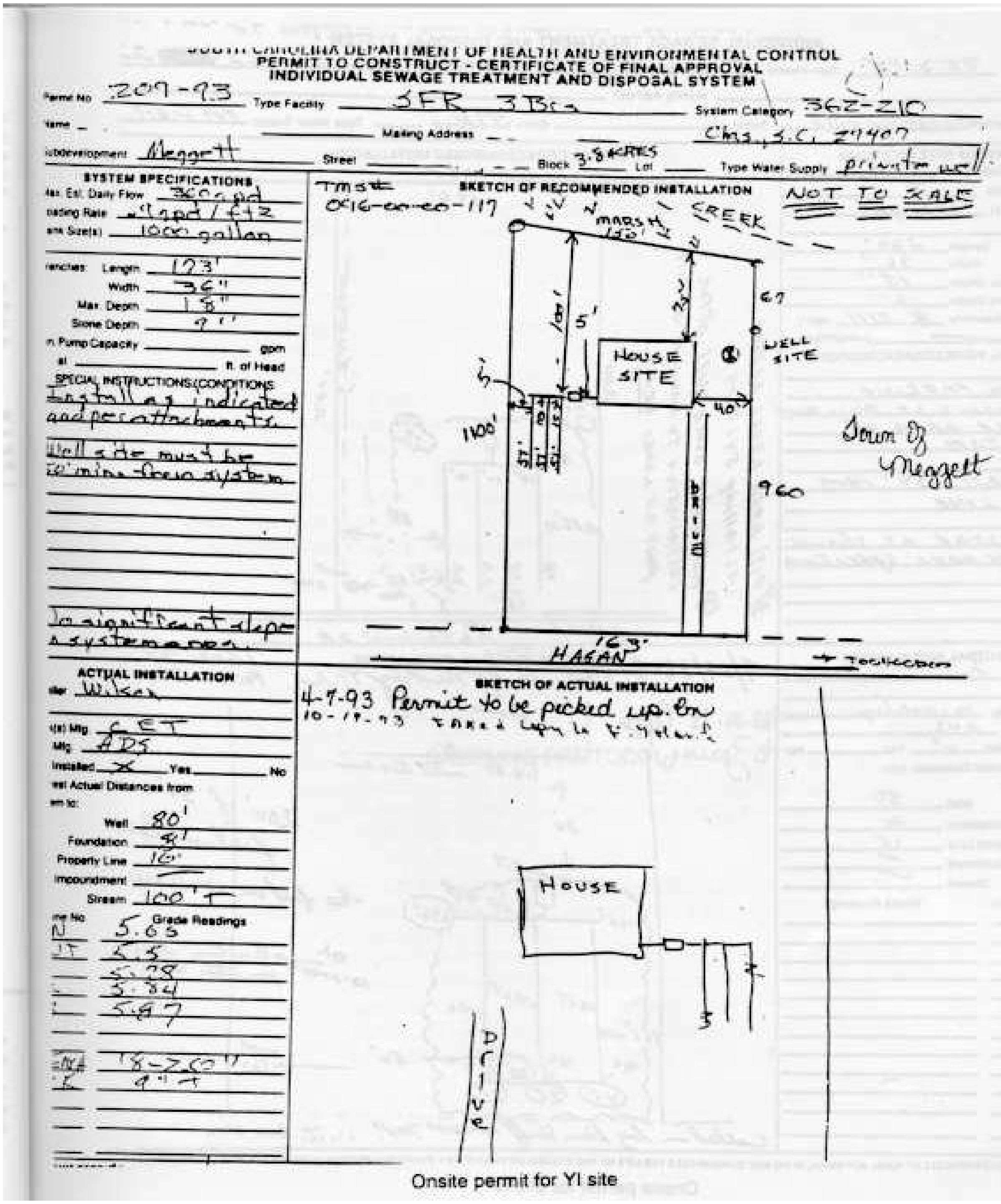
SKETCH OF ACTUAL INSTALLATION 2-5-90 Appr. to

11-20-88 Copies to be hand carried to Zoning by

2/2/90 Request for inspection by A/Na



Onsite permit for RA site



SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL
PERMIT TO CONSTRUCT - CERTIFICATE OF FINAL APPROVAL
INDIVIDUAL SEWAGE TREATMENT AND DISPOSAL SYSTEM

Permit No. 209-93 Type Facility SFR 3 Br. System Category 362-210
Name Mailing Address Chas., S.C. 29407
Subdevelopment Meggett Street Block 3.8 ACRES Lot Type Water Supply private well

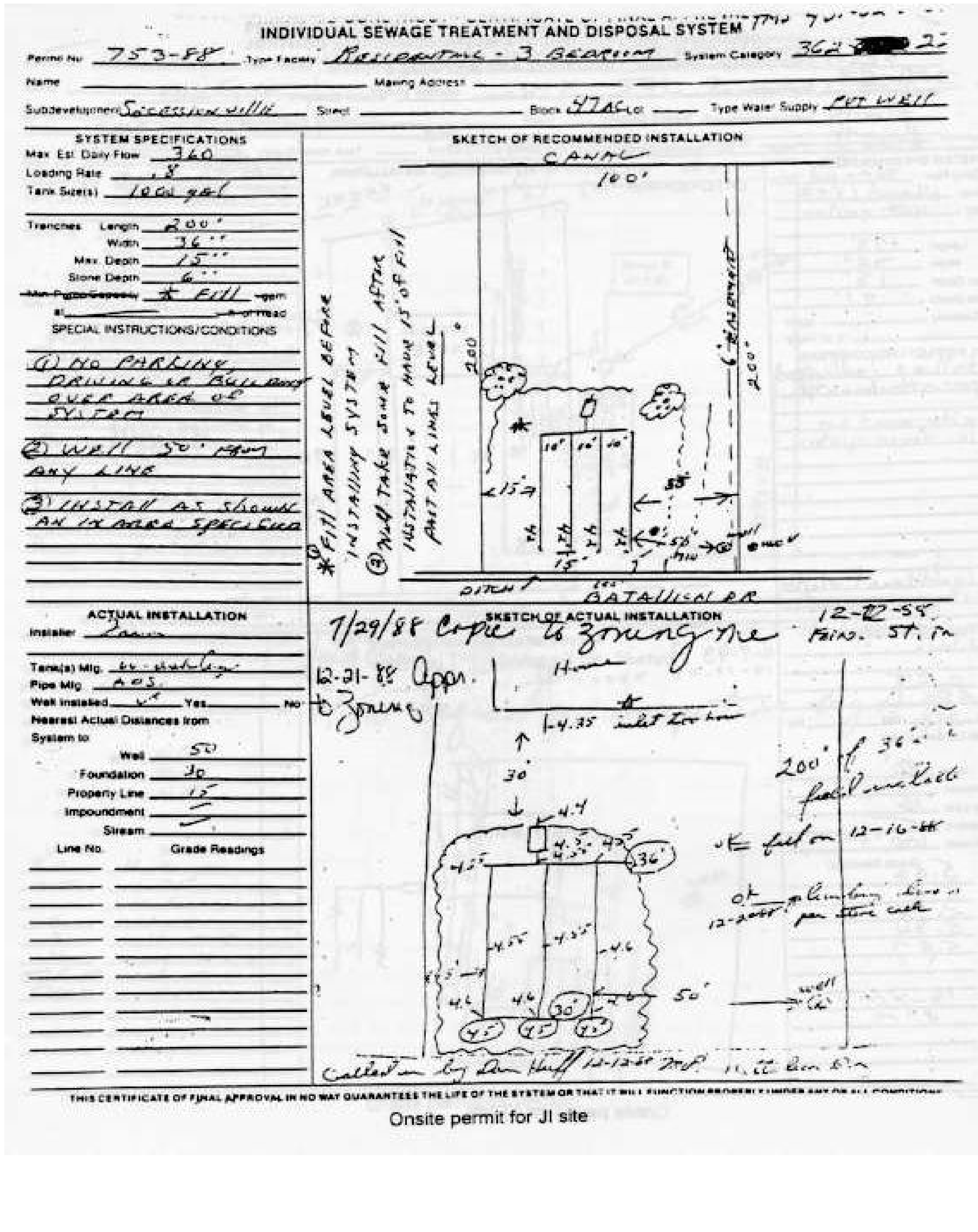
SYSTEM SPECIFICATIONS
Max. Est. Daily Flow 360 gpd
Loading Rate .9 gpd / ft2
Tank Size(s) 1000 gallon
Trenches: Length 123'
Width 36"
Max. Depth 18"
Stone Depth 9"
Min. Pump Capacity gpm
at ft. of Head
SPECIAL INSTRUCTIONS/CONDITIONS
Install as indicated and per attachments.
Well site must be 50' min. from system
No significant slope in system area.

SKETCH OF RECOMMENDED INSTALLATION NOT TO SCALE
TMS# 016-00-00-117
MARSH CREEK 150' 100' 5' 32' 67 HOUSE SITE WELL SITE 40' 5' 1100' 960 DRIVE 163' HAGAN → Toogoodoo
Town of Meggett

ACTUAL INSTALLATION
Installer Wilson
Tank(s) Mfg. CET
Mfg. ADS
Installed X Yes No
Actual Distances from System to:
Well 80'
Foundation 8'
Property Line 16'
Impoundment —
Stream 100'+
Line No. Grade Readings
5.65
5.5
5.78
5.84
5.87
18-20"
9"

SKETCH OF ACTUAL INSTALLATION
4-7-93 Permit to be picked up. Em
HOUSE DRIVE

Onsite permit for YI site



INDIVIDUAL SEWAGE TREATMENT AND DISPOSAL SYSTEM

Permit No 753-88 Type Facility RESIDENTIAL - 3 BEDROOM System Category 36? [redacted] 2

Name ______ Mailing Address ______

Subdevelopment Secession ville Street ______ Block 47AC Lot ______ Type Water Supply PVT WELL

SYSTEM SPECIFICATIONS

Max Est Daily Flow 360

Loading Rate .8

Tank Size(s) 1000 gal

Trenches Length 200'

Width 36"

Max Depth 15"

Stone Depth 6"

~~Min Pump Capacity~~ * Fill ~~gpm~~

~~at ______ ft of Head~~

SPECIAL INSTRUCTIONS/CONDITIONS

(1) NO PARKING, DRIVING or BUILDING OVER AREA of SYSTEM

(2) WELL 50' FROM ANY LINE

(3) INSTALL AS SHOWN AN IN AREA SPECIFIED

SKETCH OF RECOMMENDED INSTALLATION

CANAL 100' 200' 200' 15' DITCH BATALLION RR

* Fill AREA LEVEL BEFORE INSTALLING SYSTEM

(4) Will TAKE SOME Fill AFTER INSTALLATION TO HAVE 15" OF Fill OVER ALL LINES LEVEL

ACTUAL INSTALLATION

Installer ______

Tank(s) Mfg. ______

Pipe Mfg. ADS

Well Installed ✓ Yes ______ No

Nearest Actual Distances from System to:

Well 50

Foundation 30

Property Line 15

Impoundment —

Stream —

Line No. Grade Readings

SKETCH OF ACTUAL INSTALLATION

7/29/88 Copie to Zoning me

12-21-88 Appr. to Zoning

12-12-88 Finis. St. in

Home

200' of 36" field installed

OK field on 12-16-88

OK plumbing line on 12-20-88 per Stone ck.

well

Called in by Don Huff 12-12-88

THIS CERTIFICATE OF FINAL APPROVAL IN NO WAY GUARANTEES THE LIFE OF THE SYSTEM OR THAT IT WILL FUNCTION PROPERLY UNDER ANY OR ALL CONDITIONS

Onsite permit for JI site

APPENDIX B

SAMPLING PROTOCOL

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SAMPLING PROTOCOL

General Order of Events for Sampling

1. Calibrate pH and conductivity meters
2. Load truck with sampling equipment and supplies (see checklist)
3. Drive to site
4. Measure static water levels in wells
5. Do well volume calculations and record on field data sheets
6. Sample wells
7. Gather equipment
8. Drive to Trident EQC lab
9. Give fecal samples to bacterial lab technician
10. Acidify nitrate & ammonium samples in chemical lab
11. Log samples into EQC log book
12. Label chemical samples with assigned numbers from EQC log book
13. Wash and prep bailers
14. Collect materials needed for next sampling event

Calibration of Meters

Points to remember:

- Meters are calibrated each morning before a sampling event.
- Buffer solutions should be at room temperature
- The pH meter is an Oakton pHtestr3 with a resolution of 0.01 and +/- 0.02 pH accuracy. Follow manufacturer's calibration directions using buffer solutions pH4, pH7, and pH10.
- The conductivity meter is an Oakton TDSTester10 & 20 and has a +/- 2% accuracy. Follow manufacturer's calibration directions using standards that bracket the expected values of the groundwater. The available standards include 147, 432, 1409, and 1417 µmho/cm.

Water Level Reading and Well Sampling Order

The well order listed below is to be followed each time at each site:

1. Well 1 - Upgradient from system
2. Well 6 - Downgradient from system (furthest away)
3. Well 5 - approx. 15 feet from system (downgradient)
4. Well 4 - approx. 10 feet from system (downgradient)
5. Well 3 - approx. 5 feet from system (downgradient)
6. Well 2 - between trenches in the absorption field

Water Level Readings

The first step in collecting groundwater samples is to determine the depth to groundwater (DGW) in each monitoring well. The following procedure is followed at each well at each site:

1. Place the following supplies in the 2-gallon plastic pail which will be carried to each well: spray bottle with deionized (DI) water, the water level indicator, keys for well locks, the orange data book and pencil. The water level indicator consists of the light meter attached to the 100-foot fiberglass measuring tape.
2. Put on disposable gloves. These are to be worn at all times.
3. Remove well box cover and place inverted on ground near well.
4. Unlock well cap lock and place lock inside well box cover.
5. Remove well cap and place inside well box cover.
6. Insert water level indicator slowly into well until the meter illuminates.
7. Bob the meter a few times in order to obtain an accurate water level.
8. Read the tape measurement to the nearest 0.01 ft. at the reference point on the casing top.
9. Record measurement to the nearest 0.01 ft in the orange data book, adding 0.92 to reading to account for light meter length.
10. While removing the water level indicator, rinse with DI water from spray bottle.
11. Replace the well cap without locking.
12. Place inverted well box cover over well opening to keep out debris.
13. Repeat procedure at remaining wells.
14. If only measuring DGW, return to all wells and securely lock caps and replace well box covers. If sampling wells, continue with calculations and sampling procedure below.

Calculations For Determining Well Volume

Once depth to groundwater (DGW) is determined, the following should be calculated and recorded on the Field Data Sheets* prior to beginning well sampling procedure:

1. Determine Length of Water Column (LWC) to nearest 0.01 ft.:
   (LWC) = (TWD)** - (DGW)
2. Determine one well casing volume (OCV) in gallons:
   (OCV) = (LWC) X (0.163)
3. Determine three well casing volumes (standard evacuation volume) in gallons:
   standard evacuation volume = (OCV) x 3

* See attached Field Data Sheet for example
** TWD = total well depth

Well Sampling

After recording water levels and calculating well volumes, sampling may begin. To collect groundwater samples, wells must first be purged to remove stagnant well water. This ensures that the collected samples are representative of the groundwater in the vicinity of the well.

1. Put on a new pair of disposable gloves.

2. Using a Teflon bailer with pre-cut twine*, bail out one well volume and pour into a calibrated bucket. After one well volume, fill a 100 ml beaker with groundwater and measure pH, specific conductance, and temperature (field indicator parameters). Record measurements on field data sheet.**
3. Purge a second and third well volume, recording indicator parameter measurements. Typically, three well volumes are purged during stabilization. Purging will continue however if any of the indicator parameters vary by more than 15%.
4. Sampling begins once all field indicator parameters are stabilized.
5. The first sample is collected for dissolved oxygen (DO). Allow enough time, if possible, for the well to recharge sufficiently to fill the bailer. Note the condition of the well, the relative recharge rate, and the total volume of water purged from the well on the Field Data Sheet.
6. Collect one bailer volume and insert bottom flow sampling tip. The sampling tip ensures a slow, even stream and minimizes the introduction of oxygen into the sample.
7. The DO bottle is tilted at a slight angle and the sample tip is inserted and opened for flow. Continue until the bottle is full and allowed to overflow significantly. Withdraw the sample tip slowly while sample is still flowing. Insert the glass stopper into the DO bottle and close the sampling tip. Carefully place the bottle in the sample carrier.
8. If sufficient volume of sample remains in the bailer, fill the chloride sample bottle and then remove the sampling tip.
9. Continue to collect groundwater with the bailer, and pour into chloride, nutrient, and fecal coliform sample bottles using the v-notched top of the bailer.
10. Carry all sample bottles to the vehicle and, with the exception of the DO bottle, place securely in the cooler.
11. Perform the DO procedure (using Hach Dissolved Oxygen Test Kit Model OX-2P) according to the manufacturers directions & place DO bottle in secure area.
12. Return to the sampled well and lock the cap and replace valve box cover.
13. Put on a new pair of disposable gloves before sampling next well.

*Note: There should be one cleaned bailer per well (see section below). The bailer twine is wound around the gloved hand in a manner that does not allow the twine to ever touch the ground.

**If recharge is very slow:

1. Bail dry (measure field indicator parameters on last bailer) and allow to recharge.
2. Collect as many samples as possible and allow to recharge. Continue this procedure until all samples are taken as time will allow. Measure field indicator parameters on last bailer.

Washing and Preparing Bailers

We have a total of six bailers which allows for a bailer for each well per sampling event (there is no bailer cleaning in the field, unless an accident occurs). The bailers consist of Norwell mix & match bailer components made of 100% virgin Teflon Fluoropolymer resin. Each bailer has 6 separate pieces: a v-notched top, a one-foot bailer body, and a 3-piece “controlled flow bottom-emptying assembly” which includes a sample valve that can be inserted at sample time. Disposable bailers are used for well W-6 at the Ravenel site.To wash, disconnect all pieces and place in sink of hot water and Liquinox soap. Allow to sit for a few minutes to loosen any sand that may have entered the bailer during the sampling process.

1. Begin with the bailer body, scrub inside and out with a stiff bottle brush. Then scrub tops, bottoms and sample tips.
2. Rinse each piece three times with tap water and set aside on a clean plastic bag.
3. Rinse sampling tips again 3 times with DI water, reassemble and place each tip in a separate, new, resealable plastic sandwich bag.
4. Take tap-rinsed bailer bodies, tops, and bottoms to the DI sink. Rinse each part 3 times with DI water and assemble one set at a time. Set aside on clean plastic bag. Continue with each bailer.
5. Tie an appropriate length (based on total well depth) of nylon sampling twine to each bailer and place each bailer in a separate, clean plastic bag and seal. Once all are complete, place them in the plastic tub and close lid.
6. Load vehicle with equipment, DI & tap water (if needed) and sampling bottles for the next sampling event.

Calibration Steps for pH and Conductivity Meters

pH meter

1. Rinse 3 beakers with deionized (DI) water and shake out excess water.
2. Prepare dedicated beakers with one inch of buffer solution starting with pH 7, the second beaker with buffer pH 4, and the third beaker with buffer pH 10.
3. Remove cap and rinse pH meter probe with DI water.
4. Insert probe in buffer solution pH 7, carefully so as not to immerse over the color band. Once in solution, turn the meter on and press the “CAL” button for calibration mode. Swirl the meter and wait for the display to stabilize. Once stabilized, press the “HOLD/CON” button to confirm & complete the calibration.
5. Remove and rinse the probe with DI water and repeat steps for buffer 4 and buffer 10, in that order.
6. After all calibrations, rinse probe with DI water, turn off and replace cap.

Conductivity Meter

1. Prepare dedicated beakers each with approximately one inch of solution. There are two beakers per solution. It is best to select calibration standards that bracket the expected values of the groundwater. The available standards include 147, 432, 1409, and 1417 μmho/cm.
2. Remove cap and rinse conductivity meter probe with DI water.
3. Insert probe into first beaker of solution 1; swirl, remove and place meter in second beaker of solution 1.
4. Turn the meter on once it is placed in the second beaker of solution 1 and allow the display to stabilize.
5. Once stabilized, press “CAL/CON” button for the calibration mode.

6. Press “HOLD/INC” to move value up/down so that the display shows the value of the standard.
7. Press “CAL/CON” button again. Observe “CO” on the display, confirming calibration into memory.
8. Rinse probe with DI water & check first beaker of solution 1 to verify the calibrated value.
9. Repeat same procedure with other selected standard solution.
10. After all calibrations, rinse probe with DI water, turn off and replace cap.

APPENDIX C

RAW DATA

For copies of these appendices, please contact the SC-DHEC Office of Ocean & Coastal Management, 1362 McMillan Avenue, Suite 400, Charleston, SC 29405.

APPENDIX D

SOIL BORING LOGS

SOIL BORING LOG

SITE: Isle of Palms Site
DATE: November 7,
1995
WEATHER CONDITIONS: partly cloudy, humid, 70's
BORING LOCATION: Boring #1 - by well CB-1
Boring #2 - by well CB-2
Boring #3 - by well CB-6
BORING BY: Steve Calk
ADDITIONAL INFORMATION: The auger used is only 48 inches long, therefore the profile descriptions do not go as deep as the wells.

BORING NO.	DEPTH (in.)	TEXTURE	MATRIX COLOR	MOTTLES/WATER
1	0-3	CBS	10YR 4/3 brown	
	3-24	CBS	10YR 8/6 yellow (washed)	
	24-47	CBS	10YR 5/4 yellowish brown	SHWT > 36 in.
2	0-20	CBS	10YR 5/4 yellowish brown	
	20-33	CBS	10YR 6/3 pale brown	
	33-40	OSL	10YR 3/1 very dark gray	SHWT > 36 in.
	40+	CBS	10YR 6/3 pale brown	
3	0-15	CBS	10YR 5/4 yellowish brown	
	15-18	CBS	10YR 4/4 dark yellowish brown	
	18-47	CBS	10YR 6/4 light yellowish brown	SHWT > 36 in.

CBS = coastal beach sand
OSL = organic sandy loam
SHWT = seasonal high water table

SOIL BORING LOG

SITE: Ravenel Site
DATE: July 22, 1996
WEATHER CONDITIONS: cloudy, hot, humid
BORING LOCATION: 10 feet from well W-2, between 2 trenches, toward road
BORING BY: Steve Calk & Lisa Hajjar
ADDITIONAL INFORMATION: Due to strong septage smell and no protective gloves, boring was ceased at 72+ inches.

BORING NO.	DEPTH (in.)	TEXTURE	MATRIX COLOR	MOTTLES/WATER
1	0-4	fill		
	4-6	sl	5YR 3/1 very dark gray	
	6-12	sl	10YR 5/3 brown	9-10” few, faint mottles SHWT at 12 in.
	12-18	scl	7.5YR 6/6 reddish yellow	
	18-22	cl	7.5YR 5/6 strong brown	
	22-34	cl	7.5YR 5/6 strong brown	abundant mottles
	34-50	cl	5YR 5/8 yellowish red	abundant mottles
	50-72	sl - scl	5YR 6/8 reddish yellow	10YR 7/1 light gray (very mottled)
	72+	sl	(variable) 10G 2.5/1 greenish black	apparent water table

sl = sandy loam
scl = sandy clay loam
cl = clay loam
SHWT = seasonal high water table

SOIL BORING LOG

SITE: Ravenel Site
DATE: August 6, 1996

WEATHER CONDITIONS: cloudy, hot, humid
BORING LOCATION: 3 feet from well W-1
BORING BY: Steve Calk & Lisa Hajjar
ADDITIONAL INFORMATION:

BORING NO.	DEPTH (in.)	TEXTURE	MATRIX COLOR	MOTTLES/WATER
2	0-3.5	sl	2.5Y 3/2 very dark grayish brown	
	3.5-10	scl	10YR 5/8 yellowish brown	10YR 7/1 light gray at 10" common, medium, distinct SHWT at 10+ in.
	10-17	cl	10YR 5/8 yellowish brown	
	17-27	cl	10YR 5/8 yellowish brown	light gray mottles & iron concretions
	27-40	sc	10YR 5/8 yellowish brown	
	40-42	scl	7.5YR 5/8 strong brown	
	42-46	sc	no predominant matrix color	
	46-57	scl	no predominant matrix color	
	57-61	cl	10YR 7/1 light gray	reddish yellow
	61-63	cl	7.5YR 5/8 strong brown	
	63-69	sl	10YR 6/4 very pale brown	
	69-73	s	10YR 7/1 light gray	
	73-86	s	2.5Y 7/4 pale yellow	reddish yellow & light gray / observable water
	86+	s	2.5Y 7/2 light gray	light gray / apparent water table at 88 in.

sl = sandy loam
scl = sandy clay loam
sc = sandy clay
cl = clay loam
s = sand
SHWT = seasonal high water table

SOIL BORING LOG

SITE: Ravenel Site
DATE: August 6, 1996

WEATHER CONDITIONS: cloudy, hot, humid
BORING LOCATION: between wells W-5 and W-4
BORING BY: Steve Calk & Lisa Hajjar
ADDITIONAL INFORMATION: Indication of disturbed soils; could be spoils from ditch.

BORING NO.	DEPTH (in.)	TEXTURE	MATRIX COLOR	MOTTLES/WATER
3	0-5	sl	10YR 2/2 very dark brown	
	5-34	scl	very mixed / fill	very mottled / fill SHWT hard to call
	34-40	scl	5YR 5/8 yellowish red	10R 5/8 red
	40-66	scl	7.5 YR 5/6 strong brown	2.5Y 7/1 light gray 1 in^3 piece of slag found at 48 in.
	66-73	cl	2.5Y 7/1 light gray	7.5 YR 5/6 strong brown 10YR 7/8 yellow
	73-77	c	2.5Y 7/1 light gray	7.5 YR 5/6 strong brown 10YR 7/8 yellow
	77-108	scl	2.5Y 7/1 light gray	7.5 YR 5/6 strong brown 10YR 7/8 yellow
	108+	scl	7.5YR 5/8 strong brown	2.5Y 7/1 light gray

sl = sandy loam
scl = sandy clay loam
cl = clay loam
c = clay
SHWT = seasonal high water table

SOIL BORING LOG

SITE: Ravenel Site
DATE: August 6, 1996

WEATHER CONDITIONS: light rain, hot
BORING LOCATION: 2.5 feet from well W-6
BORING BY: Steve Calk & Lisa Hajjar
ADDITIONAL INFORMATION:

BORING NO.	DEPTH (in.)	TEXTURE	MATRIX COLOR	MOTTLES/WATER
4	0-2	sl	(did not note)	
	2-12	sl	10YR 3/2 very dark grayish brown	
	12-15	scl	5YR 5/6 yellowish red	
	15-30	scl	10YR 4/1 dark gray SHWT (?)	
	30-35	scl	10Y 4/1 dark greenish gray (may be orginal surface)	10BG 8/1 light greenish gray
	35-41	sl	5YR 2.5/1 black	
	41-46	s	10YR 3/1 very dark gray	
	46+	s	2.5Y 7/1 light gray	free water

sl = sandy loam
scl = sandy clay loam
s = sand
SHWT = seasonal high water table

SOIL BORING LOG

SITE: Yonges Island Site
DATE: August 6, 1996

WEATHER CONDITIONS: light rain
BORING LOCATION: 2.5 feet from well N-2
BORING BY: Steve Calk & Lisa Hajjar
ADDITIONAL INFORMATION:

BORING NO.	DEPTH (in.)	TEXTURE	MATRIX COLOR	MOTTLES/WATER
1	0-12	sl	10YR 3/2 very dark grayish brown	
	12-21	sl	2.5Y 5/4 light olive brown	
	21-32	sl	2.5Y 6/3 light yellowish brown	
	32-36	sl	2.5Y 7/4 pale yellow	
	36-40	sl	2.5Y 7/4 pale yellow	7.5YR 7/1 light gray SHWT at 36 in.
	40-48	sl	2.5Y 7/4 pale yellow	7.5YR 7/1 light gray 7.5 YR 6/8 reddish yellow
	48-56	ls	2.5Y 7/4 pale yellow	2.5Y 8/2 pale yellow
	56-62	ls	2.5Y 7/1 light gray	
	62-70	ls	2.5Y 6/4 light yellowish brown	7.5YR 7/1 light gray 7.5 YR 6/8 reddish yellow
	70-80	scl	2.5Y 7/1 light gray	2.5YR 4/8 red 7.5 YR 7/8 reddish yellow
	80-86	sl	2.5Y 7/1 light gray	2.5YR 4/8 (even mix with matrix)
	86-91	cl	2.5Y 7/1 light gray	2.5YR 4/8 (matrix dominates)
	91-95	sl	2.5Y 6/4 light yellowish brown	
	95-97	sl	2.5Y 7/1 light gray	10YR 7/8 yellow
	97+	scl	2.5Y 7/1 light gray	

sl = sandy loam
ls = loamy sand
scl = sandy clay loam
cl = clay loam
SHWT = seasonal high water table

SOIL BORING LOG

SITE: Yonges Island Site
DATE: June 26, 1996
WEATHER CONDITIONS: mostly cloudy, breezy, warm and humid
BORING LOCATION: approx. 2 feet behind well N-2 (away from water)
BORING BY: Lisa Hajjar
ADDITIONAL INFORMATION:

BORING NO.	DEPTH (in.)	TEXTURE	MATRIX COLOR	MOTTLES/WATER
1-a	0-5	sl	10 YR 5/3 brown	
	5-12	sl	10YR 4/3 brown	
	12-16	sl	10YR 5/4 yellowish brown	
	16-24	sl	2.5Y 6/3 light yellowish brown	10YR 2/1 black
	24-34	sl	10YR 5/6 yellowish brown	
	34-38	scl	10YR 5/6 yellowish brown	2.5Y 8/2 pale yellow (few, fine, faint) SHWT at 34"
	38-42	scl	10YR 6/6 brownish yellow	2.5Y 8/2 pale yellow (common, medium, distinct)
	42-50	scl	10YR 6/6 brownish yellow	2.5Y 8/2 pale yellow (many, coarse, prominent)
	50-54	scl	5YR 5/8 yellowish red	10YR 6/2 light brownish gray (many, coarse, prominent)
	54-58	sl	5YR 5/8 yellowish red	
	58-62	scl	5YR 5/8 yellowish red	
	62-64	sc	5YR 5/8 yellowish red	
	64-	scl	5YR 5/8 yellowish red	

sl = sandy loam
scl = sandy clay loam
SHWT = seasonal high water table

SOIL BORING LOG

SITE: James Island Site

DATE: July 9, 1986

WEATHER CONDITIONS: dry

BORING LOCATIONS: Boring #1: 25 feet from ditch toward house and 40 feet from property line opposite driveway. Boring #2: 50 feet from ditch and about 50 feet from property line by driveway. Boring #3: 75 feet from creek and 60 feet from property line by driveway.

BORING BY: Bill Britt (Chas. Co. Health Dept.)

ADDITIONAL INFORMATION: Borings were done in 1986, when lot was being re-evaluated for septic system (permit was originally issued in 1979 and had to be honored due to grandfather clause). Original data did not include Munsell color notations, only color names.

BORING NO.	DEPTH (in.)	TEXTURE	MATRIX COLOR	MOTTLES/WATER
1	0-16	ls	grayish brown	fill material
	16-27	sl	very dark grayish brown	shells mixed in
	27-36	sl	washed gray	
2	0-12	fls	brown	
	12-21	ls	yellow, red, & brown	gray & red mottles (fill)
	21-29	ols	dark gray	original soil
	29-36	ls	pale gray, brown	bleached out (soil wet)
3	0-6	fls	brown	
	6-16	ls & c	brown, red, gray & shells	soil mixed w/ shell & marl (fill)
	16-26	mixed texture	red, yellow, gray & brown	fill material
	26-30	ols	black	original soil (wet & organic)

ls = loamy sand
sl = sandy loam
fls = fine loamy sand
ols = organic loamy sand (textural class used by the Health Department)
SHWT = seasonal high water table